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Technological adoption: the case of PIX in Brazil

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Abstract

Purpose – This study investigates the primary determinants of consumers' intention to adopt PIX as a payment method in Brazil, as well as their actual usage behavior.

Design/methodology/approach – The study employs the Unified Theory of Acceptance and Use of Technology (UTAUT) to analyze both the intention to use and the actual period of use of PIX technology as a measure of practical usage. With this approach, researchers can determine whether people's intention to use PIX translates into a higher rate of technology adoption and effective and sustained usage. The study collected data from 659 consumers across Brazil through a questionnaire and used structural equation analysis to analyze the data.

Findings – Research suggests that the intention to adopt PIX as a payment method is mainly determined by the perceived value, performance expectancy, and the habit of using mobile internet. Positive associations are also confirmed between adoption intention, the effective usage time of PIX, and the habit of using mobile internet in conjunction with PIX use.

Originality/value – The study's uniqueness stems from its focus on the PIX usage, which is becoming the primary payment method in Brazil. It also measures the practical usage of the technology by examining the duration of user experience. This enables the assessment of whether the intention to use PIX effectively translates into a higher speed of technology adoption.

Keywords PIX, Payment system, Intention, Technological adoption, UTAUT2

Paper type Research paper

1. Introduction

In November 2020, the Central Bank of Brazil (BACEN) introduced a new instant payment system called PIX. Its purpose is to further digitize payment methods in the country, offering a financial transaction tool with greater operational availability, accessibility, agility, and lower costs compared to previously available alternatives (BACEN, 2020). In its fifth quarter of operation, the PIX system had already accumulated more than 3.9bn transactions (approximately 21% of the total financial transactions in Brazil) and R$1.9tn in financial volume (equivalent to 8.9% of the total), indicating a high level of consumer adoption.

Indeed, the adoption of new payment technologies is a topic under discussion in the academic literature. Some authors investigate the factors influencing consumer behavior in the face of technological innovations, whether in person-to-person payment methods (Lara-Rubio, Villarejo-Ramos, & Liébana-Cabanillas, 2020), the adoption of banking apps (Wang, Lin, & Luarn, 2006; Luarn & Lin, 2005; Yu, 2012), or the use of mobile payments in general (Andreev, Pliskin, & Rafaeli, 2012; Koenig-Lewis, Marquet, Palmer, & Zhao, 2015). However, PIX, being a recently implemented system with unique functional and structural characteristics, has not been the subject of many studies, especially concerning the factors

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determining its adoption. Understanding these factors is crucial for both regulators and institutions participating in the system when making decisions regarding minimum usability requirements of the tool, the creation or adjustment of functionalities available within the system, regulatory adjustments, among others. In the private sector, understanding the behavioral factors associated with the consumer adoption of PIX is strategically relevant for the design, marketing, and security decisions of financial institutions.

In this context, the aim of this study is to investigate the key factors influencing the intention to adopt PIX and its effective usage as a payment and transfer instrument among Brazilian consumers. The use of the Unified Theory of Acceptance and Use of Technology (Venkatesh, Thong, & Xu, 2012) seeks to analyze consumer behavior towards the acceptance of new technologies (in our case, PIX) to explain their intention to use it and their actual adoption behavior. To achieve this, a sample of 659 respondents from all regions of the country is examined by using a structural equation model.

The main results indicate that user expectations regarding the benefits and convenience provided by PIX, as well as their familiarity and prior habits of using mobile internet, are the two main factors associated with the behavioral intention to adopt PIX as a payment method. Furthermore, the intention to use PIX is linked to the duration of PIX usage, suggesting that behavioral intention indeed translates into a higher speed of adoption of the payment system.

This study makes three main contributions. First, the results contribute to the discussion of adopting new payment instruments in the context of a developing country (Kingiri & Fu, 2020; Zanello, Fu, Mohnen, & Ventresca, 2016). Second, it investigates relationships – already observed in other countries for different payment technologies – between behavioral factors and the intention to adopt payment technologies in the context of PIX in Brazil. Finally, the proposed model adopts the user's experience duration with the technology as a measure of effective usage, which expands upon the original theory where the conceptual model was based on a binary measure for effective usage.

2. Theoretical framework

In this section, we will present the context of the PIX payment system in Brazil and the theory of acceptance and use of new technologies developed by Venkatesh, Morris, Davis, and Davis (2003), Venkatesh *et al.* (2012).

2.1 PIX: basic aspects

PIX is an instant payment system created and regulated by the Central Bank of Brazil in November 2020. Transactions via PIX can be initiated through the apps of financial or payment institutions, physical branches, or smartphones. However, smartphones are expected to be the primary channel for users to access the instant payment system. PIX has the potential to drive the digitization of the retail payment market, enhance market competitiveness and efficiency, reduce costs, increase security, and improve customer experience. Additionally, it aims to promote financial inclusion and address several gaps in the range of payment instruments currently available to the country's population (BACEN, 2020).

PIX has sparked research interest in various areas. The implementation of instant payments for distributing funds from insurers to policyholders is one of the topics addressed by Costa, Cappellozza, and Moraes (2021), emphasizing transaction availability, speed, and security. Duarte *et al.* (2022) highlight the mandatory participation of major banks and the dual role of the Central Bank (as an infrastructure provider and a regulator) as key factors for PIX's success. Lobo and Brandt (2021) also emphasize the multiplicity of use cases, convenience, security, low cost, and reconciliation as key factors for PIX's success, while

exploring the role of the Central Bank in the implementation, management, and operation of the new payment method. Camacho and da Silva (2022) compare the Indian experience of the Unified Payments Interface (UPI) with PIX, highlighting the importance of financial innovation, mobile banking adoption, and internet access for economic development. Mantovani and Lucas (2022) address the unexpected use of PIX for flirting, highlighting the importance of user-technology interaction. Bolzani (2022) underscores the importance of financial institutions' intervention in promoting financial inclusion and competition in the payment market. Finally, Do Vale, Da Silva Pinto, Marques, and Teodoro (2022) present PIX as a solution that enhances payment efficiency and security by transferring funds between accounts in seconds but raises questions about legal authority and competition with private companies. Collectively, these studies emphasize the significance of PIX in promoting financial inclusion and economic development in the country, as well as its various aspects and challenges to be addressed.

Nevertheless, although PIX has some unique characteristics when compared to other digital payment methods (especially regarding its operation, technology, and regulation), from the consumer's perspective, there are several similarities—especially concerning the purposes of transfers and facilitating payments. In other words, PIX can be framed and examined within the context of adopting new technologies.

2.2 Hypotheses

The adoption of digital payment technologies is often studied through technology acceptance models (Patil, Dwivedi, & Rana, 2017), which were developed based on behavioral theories from the fields of psychology and sociology. Notably, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003) is a comprehensive synthesis of eight previously established technology acceptance and usage theories in the literature, primarily focusing on the organizational context. Years later, the same authors proposed an extension of the original model specifically for consumer technology acceptance, known as UTAUT2 (Venkatesh *et al.*, 2012).

UTAUT2 has been used in academic studies. For instance, Chen, Salmanian, and Akram (2017) applied the model to examine user acceptance of ride-sharing companies in China, such as Uber and Didi. Soares, Christino, Gosling, Vera, and Cardozo (2020) assessed the factors predicting the intention to use Uber in Brazil. Chopdar, Korfiatis, Sivakumar, and Lytras (2018) investigated the factors influencing mobile app-based shopping behavior in India and the USA, while Abegão Neto and Figueiredo (2022) studied the intention to use mobile payment apps in Brazil. Zhou *et al.* (2021) focused on characterizing Chinese consumers' intention to use live e-commerce, while Kalinić, Marinković, Djordjevic, and Liebana-Cabanillas (2019) examined customer satisfaction with mobile commerce and their willingness to recommend it. Recent studies have also explored the acceptance and use of mobile banking apps in South Africa (Thusi & Maduku, 2020), the impact of key UTAUT2 antecedents on the behavioral intention to adopt and use mobile payment systems in India (Gupta & Arora, 2020), and the influence of factors encouraging smartphone fitness app users in the United States to engage in physical activity (Yang & Koenigstorfer, 2021). Furthermore, other current studies apply the UTAUT2 model to analyze the determinants of consumer behavioral intention to use mobile apps in Malaysia (Hew, Lee, Ooi, & Wei, 2015), tourist adoption of smartphone apps (Gupta, Dogra, & George, 2018), and mobile learning apps among Ghanaian university students (Penney, Agyei, Boadi, Abrokwah, & Ofori-Boafo, 2021).

UTAUT2 suggests the following constructs as responsible for the intention to use and effective use of new technologies: Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value, and Habit.

Performance Expectancy represents how useful the technology in question is in achieving the individual's intended goals (Venkatesh *et al.*, 2012). Thus, a high-performance expectancy regarding a technology indicates a perception that through it, the individual can enhance their performance, and therefore make its adoption advantageous.

Oliveira, Thomas, Baptista, and Campos (2016) and Slade, Williams, Dwivedi, and Piercy (2014), Slade, Dwivedi, Piercy, and Williams (2015) found a significant positive association between Performance Expectancy and the intention to use various digital payment technologies in Portugal and the UK. Since the transfer and payment functionalities of PIX offer a faster and more accessible payment method than consumer alternatives, this payment method can provide benefits that favor the intention to adopt it. Therefore:

H1. Performance Expectancy is positively associated with the intention to adopt PIX as a payment method.

Effort Expectancy is the degree of ease associated with using a particular technology by consumers (Venkatesh *et al.*, 2012). When a consumer believes that a certain technology is easy to use and requires minimal effort, they are more likely to have higher expectations of achieving their intended goals (Venkatesh *et al.*, 2003). Some studies indicate that this construct has no significant association with the intention to use specific digital payment technologies (Slade *et al.*, 2014, 2015).

Oliveira *et al.* (2016) provide evidence that lower effort expectancy results in higher expectations of benefits linked to the use of mobile payments, but it's not necessarily connected to greater technology adoption. However, Thakur (2013) and Wang and Yi (2012) found evidence that effort expectancy has a significant association with the intention to use mobile payments in India and China, respectively. Since various minimum usability criteria are established to ensure a simple and intuitive user experience, it is likely that there is a positive association between Effort Expectancy and the intention to adopt PIX as a payment method. Therefore:

H2. Effort Expectancy is positively associated with the intention to adopt PIX as a payment method.

Social Influence is the degree to which a consumer believes that important people in their life think they should use a particular technology (Venkatesh *et al.*, 2012). The mechanism behind this construct is that individuals consult their social interaction networks to reduce the insecurity and uncertainty they feel about new technologies.

Yu (2012) found evidence of a positive association between Social Influence and the Intention to use mobile banking services in Taiwan. With the rapid adoption of PIX observed in its first year of operation, it is likely that both current and potential users consult their network of contacts to seek reassurance that the system is secure and functions well, and this positively influences the intention to adopt PIX as a payment method. In other words,

H3. Social Influence is positively associated with the intention to adopt PIX as a payment method.

Finally, Facilitating Conditions refer to the consumer's perception of the resources available that will help them use the technology—such as having the necessary knowledge, technological resources, tools, and assistance from other people. Some studies provide evidence of the association of this construct with the Intention to Use (Thakur, 2013), while most studies observe a significant association of facilitating conditions only with the effective use of technology (Slade *et al.*, 2014; Oliveira *et al.*, 2016).

Venkatesh *et al.* (2003) dismiss the existence of a direct relationship between this construct and the intention to use. However, the authors empirically identified facilitating conditions as a direct determinant of intention to use and effective use (Thakur, 2013; Koenig-Lewis *et al.*,

2015). In this context, and considering the minimum technical infrastructure guaranteed by the Central Bank of Brazil (BACEN) within the apps of PIX participant institutions—which leads to a simple and intuitive user experience—it is likely that the perception of support to facilitate the use of PIX influences both the intention to use and a longer effective use of PIX as a payment method. Therefore:

H4a. Facilitating Conditions significantly influence the intention to adopt PIX as a payment method.

H4b. Facilitating Conditions are positively associated with the Effective Usage Time of PIX as a payment method.

Hedonic Motivation is associated with the positive feelings (such as fun or pleasure) linked to the use of technology. Although Slade *et al.* (2014) found a positive and significant association of this construct with the intention to use a specific mobile payment method, Oliveira *et al.* (2016) did not find evidence supporting this association for mobile payments as a whole. Considering the specific context of PIX, which is essentially functional in nature, there does not appear to be a clear mechanism to support the association of this construct with the intention to adopt PIX.

On the other hand, Value for Price pertains to the perceived cost-benefit relationship that consumers have regarding a given technology (Venkatesh *et al.*, 2012). Given BACEN's emphasis on the potential of PIX to eliminate intermediaries and its free usage for individuals (thus, cheaper than available alternatives), while offering instant and highly available transfers, we derive the following hypothesis:

H5. Value for Price is positively associated with the intention to adopt PIX as a payment method.

Habit is associated with a consumer's tendency to gravitate towards technologies they are already familiar with (Venkatesh *et al.*, 2012). Although PIX is an innovative technology, Brazilian consumers are quite accustomed to using smartphones, and nearly 100% of Brazilians who use the internet do so partially or exclusively through smartphones (PNAD, 2019). Thus:

H6a. Habit of using Mobile Internet is positively associated with the intention to adopt PIX as a payment method.

Venkatesh *et al.* (2012) suggest the existence of a direct positive association between habit and effective use, which makes sense in the case of PIX; the habit of using mobile internet favors individuals being immersed in the context of relevant innovations like PIX and being early adopters of the technology. Moreover, as discussed in Venkatesh *et al.* (2012), the theories that originated UTAUT2 suggest that the act of repeatedly performing certain actions gives rise to "contextual triggers." Thus, once the contextual triggers linked to behavioral intention are activated, behavior is automatically guided by behavioral intention, without the need for conscious effort (e.g. belief formation). Therefore:

H6b. Habit of using Mobile Internet is positively associated with the Effective Usage Time of PIX as a payment method.

Finally, it is suggested that behavioral intention has a positive and significant influence on the Effective Use of Technology. Considering that the ultimate goal of companies, providers, and regulators is to achieve effective adoption of their technologies, examining how intention translates into effective behavior is highly relevant. Thus, we propose:

H7. The Intention to Use PIX as a payment method is positively associated with the Effective Usage Time of PIX as a payment method.

Although UTAUT2 argues in favor of including age, gender, and experience as moderating variables for some of the relationships described above, we will not explore such relationships in this study. This choice resonates with most of the literature supported by UTAUT and its extensions (Williams, Rana, Dwivedi, & Lal, 2011). Nevertheless, age, gender, education, and social class are included in the model and adopted as control variables.

3. Methodology

To test the hypotheses, data were collected through an online questionnaire constructed from questions whose association with the constructs we intend to analyze is well-established in the literature (Venkatesh *et al.*, 2012). A direct translation of the original English items into Portuguese was conducted by a qualified professional, with sensitive contextual adjustments connected to the PIX context to retain the essence of each item.

The questions associated with the proposed constructs have responses that range from 1 to 7, following a Likert scale. The questionnaire was presented to a small sample of 10 individuals to collect feedback on the number of questions and response time.

The respondent base consisted of 659 individuals with internet access, following the sociodemographic distribution of Brazilian internet users and smartphone users, according to the TIC Household Survey 2019/2020, and following the quotas of the Brazilian population that uses mobile internet, as provided by IBGE in the 2017 PNAD. Data were collected based on country region, gender, and age (details of the sample distribution are in the Supplementary File 1). For the distribution of surveys, OpinionBox, a company that specializes in market research, was hired. A total of 700 individuals were interviewed, of which 41 were discarded through an attention check that required typing the year in which the questionnaire was being answered (2022).

The intention to adopt PIX as a payment method and the effective usage time of PIX were adopted as dependent variables. Note that while the first variable was directly collected from the questionnaire, the second one was created from the overlap of the variables (i) experience – which describes the number of months since the individual first used PIX - and (ii) effective use of PIX – a binary variable, adopted in UTAUT2, regarding whether the individual has used PIX at any point.

The dimensions of performance expectation (4 items), effort expectation (4 items), social influence (3 items), facilitating conditions (4 items), value for price (3 items), and habit of using mobile internet (3 items) were used as explanatory variables. Information on age, gender, social class, and education was also collected to assess the sample's profile and will be considered as control variables.

Structural Equation Modeling (SEM) was used to analyze the data as it allows for a simultaneous analysis of all proposed relationships, combining the results of multiple regression with factor analysis (Hair, Anderson, Tatham, & Black, 1998). This methodology allows observed and latent variables to be analyzed simultaneously, in addition to providing fit statistics for the complete model (Mathieu & Taylor, 2006; Tabachnick & Fidell, 2007). The maximum likelihood estimation was performed in Stata.

4. Results

The sample consists of 52.2% women, with a concentration of respondents in the Southeast and Northeast regions of the country (73.6% of respondents in these two regions), and 83% of respondents in social classes C, D, and E (C for working class, D for working poor and E for poverty level), which correspond to the country's reality and aligns with the population distribution using mobile internet according to IBGE (PNAD, 2019), making it a representative sample of the country. Approximately 56% of respondents are between 18

and 34 years old. Finally, it is worth noting that less than 5% (28 respondents) have never used PIX as a payment method. The sample profile is presented in the Supplementary File 1 and the descriptive measures and standardized factor loadings of the scale items are in Supplementary File 2.

As indicated by Table 1 - Panel A, there is high internal consistency in the scales. All Cronbach's Alpha values are above 0.7, and the percentage of variance explained by the first factor is over 60% for all cases (Hair *et al.*, 1998). The convergent validity of the dimensions was confirmed by using the average variance extracted (AVE), all of which are above 0.5 (Hair *et al.*, 1998). Furthermore, the KMO values, above 0.5 for all dimensions, indicate that the sample size is adequate for the extraction of a single factor (Hair *et al.*, 1998).

The means, standard deviations, and correlations of the mean scores of each of the dimensions are presented in Table 1 - Panel B. As can be observed, all dimensions have positive correlations, as expected. It is noteworthy that there is a strong correlation between performance expectation and effort expectation (0.72), which may generate moderate multicollinearity in the models, but it is not so strong (above 0.9 in absolute value) as to impair estimation according to Wooldridge (2010). Discriminant validity (Table 1 - Panel C) was analyzed by using the squared correlations between latent variables, with only one value above the lowest AVE value, 0.58, thus indicating that discriminant validity is compromised for performance expectation and effort expectation, but the correlation is not considered strong enough to compromise modeling.

The results are detailed in Table 2 and Supplementary File 2: Questionnaire Items, Descriptive Measures, and Standardized Factor Loadings (Confirmatory Factor Analysis). It is worth noting that the RMSEA fit measure for the model is 0.10, at the tolerance limit recommended by Hair *et al.* (1998). The NFI (normalized fit index) - an adjustment indicator analogous to R2, ranging from 0 (no fit) to 1 (perfect fit) - was slightly below the recommendation of 0.8 (Browne & Cudeck, 1993), but still reached a high value (0.752). Furthermore, by using the minimum discrepancy (CMIN) divided by degrees of freedom (DF), it can be considered that the model has reasonable fit (CMIN/DF = 4153/531 = 7.82), as values less than 2 or greater than 5 indicate reasonable model fit (Marsh & Hocevar, 1985).

As observed in the first column of Table 2, hypotheses H1, H5, and H6a are confirmed - considering a 5% significance - while in the second column, we have confirmation of hypotheses H6b and H7.

In the relationships where the intention to use PIX is the dependent variable, we observe a positive and significant relationship with performance expectation (H1). In line with our expectations, we also observe positive coefficients, albeit of lower magnitudes, for value (H5)

Dimension	Number of items	Cronbach's alpha	KMO	Eigenvalue	Explained variance (%)	AVE
Performance expectation	4	0.89	0.80	3.04	0.76	0.68
Effort expectation	4	0.95	0.86	3.49	0.87	0.83
Social influence	3	0.88	0.72	2.42	0.81	0.72
Facilitating conditions	4	0.76	0.78	2.64	0.66	0.58
Value	3	0.81	0.67	2.22	0.74	0.63
Habit	4	0.79	0.74	2.61	0.65	0.62
Behavioral intention	3	0.93	0.75	2.64	0.88	0.83

Note(s): The Eigenvalue and Explained Variance refer to the first principal component. AVE, Average Variance Extracted
Source(s): Table by authors

Table 1 - Panel A. Cronbach's Alpha, KMO (Kaiser-Meyer-Olkin), first eigenvalue, percentage of variance explained by the first principal component, and average extracted variance

Table 1 - Panel B. Descriptive measures of construct scores

Score Correlações	1	2	3	4	5	6	7
1. Performance expectation	1						
2. Effort expectation	0.72	1					
3. Social influence	0.60	0.48	1				
4. Facilitating conditions	0.59	0.56	0.46	1			
5. Value	0.51	0.49	0.40	0.53	1		
6. Habit	0.54	0.52	0.51	0.60	0.49	1	
7. Behavioral intention	0.70	0.61	0.52	0.57	0.53	0.56	1
Mean	6.25	6.50	5.88	6.23	6.07	5.99	6.15
Standard deviation	1.20	1.02	1.45	1.03	1.23	1.15	1.35

Source(s): Table by authors

Table 1 - Panel C. Squared correlations between latent variables (discriminant validity)

Latent variable	1	2	3	4	5	6
1. Performance expectation	1					
2. Effort expectation	0.65	1				
3. Social influence	0.42	0.24	1			
4. Facilitating conditions	0.48	0.51	0.21	1		
5. Value	0.37	0.31	0.20	0.42	1	
6. Habit	0.42	0.49	0.25	0.53	0.37	1

Source(s): Table by authors

Table 2. Results of structural equation modeling

	Direct effects	
	Response variable	
Variable	Behavioral intention	Time of use of PIX
Performance expectation	0.533*** (<0.001)	
Effort expectation	−0.076 (0.111)	
Social influence	0.049* (0.086)	
Facilitating conditions	0.075 (0.146)	0.365 (0.116)
Value	0.139*** (<0.001)	
Habit	0.507*** (<0.001)	0.6733** (0.032)
Behavioral intention		0.733*** (0.002)
Age	−0.001 (0.595)	−0.045*** (<0.001)
D_Female gender	−0.039 (0.440)	−0.7032** (0.014)
D_Class B	−0.216 (0.204)	−1.031 (0.286)
D_Class C	−0.223 (0.174)	−1.117 (0.230)
D_Class D	−0.101 (0.552)	−1.995** (0.039)
D_Class E	−0.1755 (0.314)	−3.190*** (0.001)
D_Elementary_Educ	−0.155 (0.541)	1.769 (0.219)
D_High School_Educ	−0.262 (0.265)	1.830 (0.169)
D_Higher_Educ	−0.283 (0.235)	2.288* (0.090)
D_Postgraduate_Educ	−0.450* (0.066)	2.444* (0.078)
Constant		11.419*** (<0.001)

Note(s): Significance at: 1% ***; 5% **; 10% *. *P*-value in parentheses
Source(s): Table by authors

and the habit of using mobile internet (H6a). It is worth noting that the highest coefficient is for performance expectation, in line with another similar study mentioned in the literature review (Slade *et al.*, 2014).

Regarding effective usage, there is a positive and significant relationship between usage intention and effective usage time, indicating that the behavioral intention to adopt PIX is indeed translating into longer-term usage behavior, as anticipated in H7. Additionally, the habit of using mobile internet also has a direct relationship with effective usage behavior, confirming H6b.

We did not find results supporting the relationships between effort expectation, social influence, facilitating conditions, and price with the intention to use PIX. This makes sense since PIX is a technology easily accessible to mobile internet users, used by all social classes, and with no transaction cost.

Other interesting findings include: older individuals, women, individuals from classes D and E (working poor and poverty level, respectively), and people with higher education and postgraduate degrees tend to use PIX for a shorter time than others.

5. Discussion

In this study, we conducted a confirmatory analysis of the behavioral factors that determine an individual's intention to adopt PIX as a payment method and how this intention translates into effective use of the technology. We proposed a conceptual model based on the Unified Theory of Acceptance and Use (Venkatesh *et al.*, 2012) and adapted it for the intended analysis.

The SEM model estimated with a sample of 659 respondents from Brazil confirms most of the hypotheses. The intention to adopt PIX is positively and significantly associated with Performance Expectancy (H1), Habit of Using Mobile Internet (H6a), Value (H5), and Social Influence (H3), in decreasing order of relevance. As expected, Facilitating Conditions do not have a significant association with behavioral intention (H4a). However, we also did not find valid associations with Effort Expectancy (H2), as predicted by the literature. On the other hand, the Effective Use Time of PIX showed a positive and significant association with Behavioral Intention (H7) and Habit of Using Mobile Internet (H6b).

We also found that older individuals, females, and those from lower socioeconomic classes tend to use PIX for a shorter period of time than comparable groups. Conversely, there is evidence that individuals with more years of education use PIX for a longer time.

One of the contributions of this study is the measurement of effective PIX use as the time of technology use, different from the original UTAUT2 model, which only indicates whether the individual uses the technology or not (i.e. a binary variable). By adopting the user's experience time with the technology as a measure of effective use, we obtain more detailed information and assess the relationship of these UTAUT2 dimensions with the time of effective use, which has not been done in other articles on the topic. In addition to this, the results corroborate, in the case of PIX, associations similar to those verified in other geographies, for different payment methods. This area had not been widely explored in the literature due to the recent implementation of PIX. Furthermore, from a broader perspective, the results contribute to the expansion of the discussion of the adoption of new payment technologies in developing countries (Chopdar *et al.*, 2018; Gupta & Arora, 2020; Kalinić *et al.*, 2019; Thusi & Maduku, 2020; Zhou *et al.*, 2021).

However, it is worth noting some limitations of the study. First, only factors from UTAUT2 were incorporated, without the inclusion of constructs from other theories of technological acceptance. Such constructs as Perceived Security were adopted to analyze the adoption of mobile payments in China (Zhong, Dhir, Nieminen, Hämäläinen, & Laine, 2013), arguing that concerns regarding security in using a payment technology can be significantly associated with the intention to adopt it. Such a factor could be an interesting inclusion for the analysis of PIX, a system that was used during express kidnappings in its early months of operation. Another limitation of the study is that we did not conduct an exhaustive

exploration of all the proposed relationships in the original model (Venkatesh *et al.*, 2012), such as the moderating effect of age on the relationship between Facilitating Conditions, Value for Price, and Habit with Behavioral Intention.

Due to the relevance that the PIX system has gained since its implementation, it is also worth noting that there is ample opportunity for further research in various areas, such as: studying the factors responsible for the intention and effective adoption of PIX among companies; factors for discontinuing the use of PIX by individuals already accustomed to the solution; studying the determining factors for the adoption of other technologies and systems related to PIX, stemming from the Open Banking front of the Central Bank of Brazil. This type of analysis provides information on which success points have been achieved by the institutions responsible for this front of financial innovation while it also allows for a better understanding of the behavioral characteristics of the Brazilian consumer, verifying the main factors that determine their susceptibility to financial technological innovations, essential for the modernization of the financial and payment market in Brazil.

5.1 Implications for practice

The results of this study have practical implications as they demonstrate the key factors considered by individuals when it comes to the intention to adopt the PIX System. They also illustrate that the existence of this behavioral intention did indeed result in a faster adoption of the technology, a primary objective for the Central Bank of Brazil as the regulator and for the participating institutions as providers.

Managers who observe results indicating that the intention to adopt PIX is positively affected by such factors as the perception that PIX can increase user productivity may direct communications and marketing campaigns to emphasize and illustrate this aspect. Similarly, results that show that individuals' social influence network has a positive association with the intention to adopt PIX can assist in designing financial products that involve the collective use of PIX, leveraging this effect (e.g. splitting household bills using PIX). Another interesting result is the positive association between Effective Use Time of PIX and the Habit of Using Mobile Internet. This may indicate that users who already have the habit of conducting financial transactions through mobile devices are more willing to adopt PIX as a payment method. This is relevant for innovation management, as it may suggest that marketing campaigns targeting mobile device users could be more effective in promoting PIX.

6. Conclusions

This paper provides evidence that various factors influence both the intention to adopt PIX and its effective use. The study confirms the importance of Performance Expectancy, Habit of Mobile Internet Use, Value, and Social Influence in individuals' decision to adopt the new payment method. Additionally, it was observed that Facilitating Conditions had no significant association with the adoption intention, which may indicate that the ease of using PIX is already perceived by users and no longer affects the decision to adopt it. However, it is noteworthy that there was no valid association between Effort Expectancy and behavioral intention, contrary to the existing literature on the subject. This is important information for innovation management, as it may indicate that reducing the effort required to use PIX is not a relevant concern for users, and other strategies should be adopted to stimulate adoption.

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Appendix

The supplementary material for this article can be found online.

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